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(54) Vibratory paper feed device

(57) A paper feed device comprises support frames 21, 22 disposed parallel to each other, and a rotation shaft 29 journaled in the support frames and upon which feed rollers 28 are fitted. The feed rollers 28 are imparted with vibrations in a direction perpendicular to the paper feed direction. Thus single sheets of paper may be fed from a pile by the rotation of the vibrating paper feed rollers 28 located thereabove.

FIG. 3

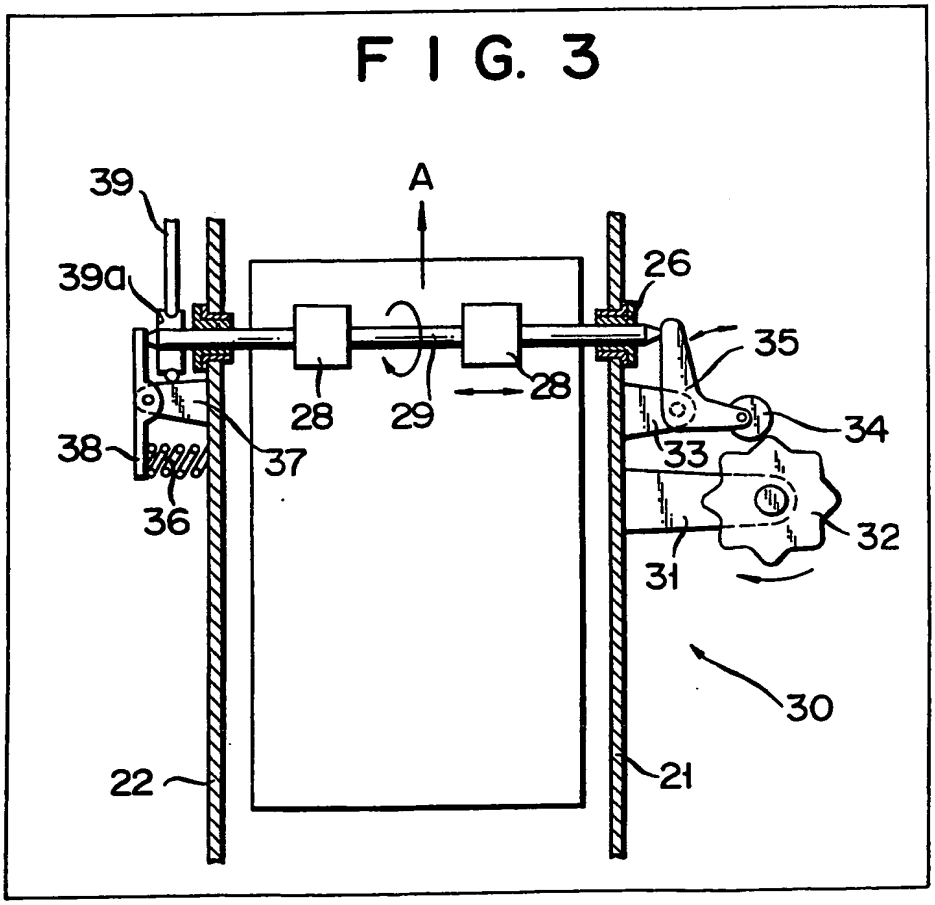

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FIG. 1

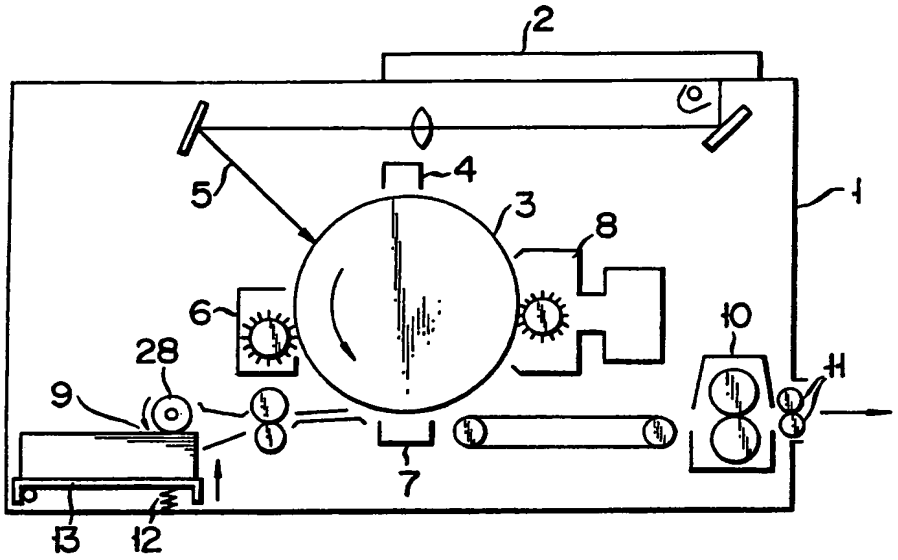
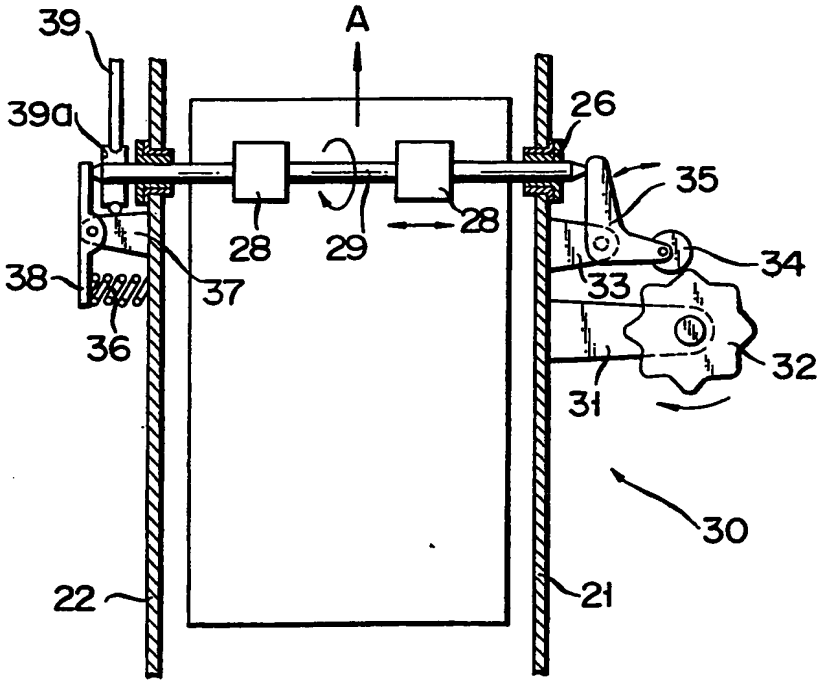

2
5
4
3
8
1
6
10
28
11
9
7
13
12

FIG. 3


39
A
39a
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35
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37
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22
21

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FIG. 2

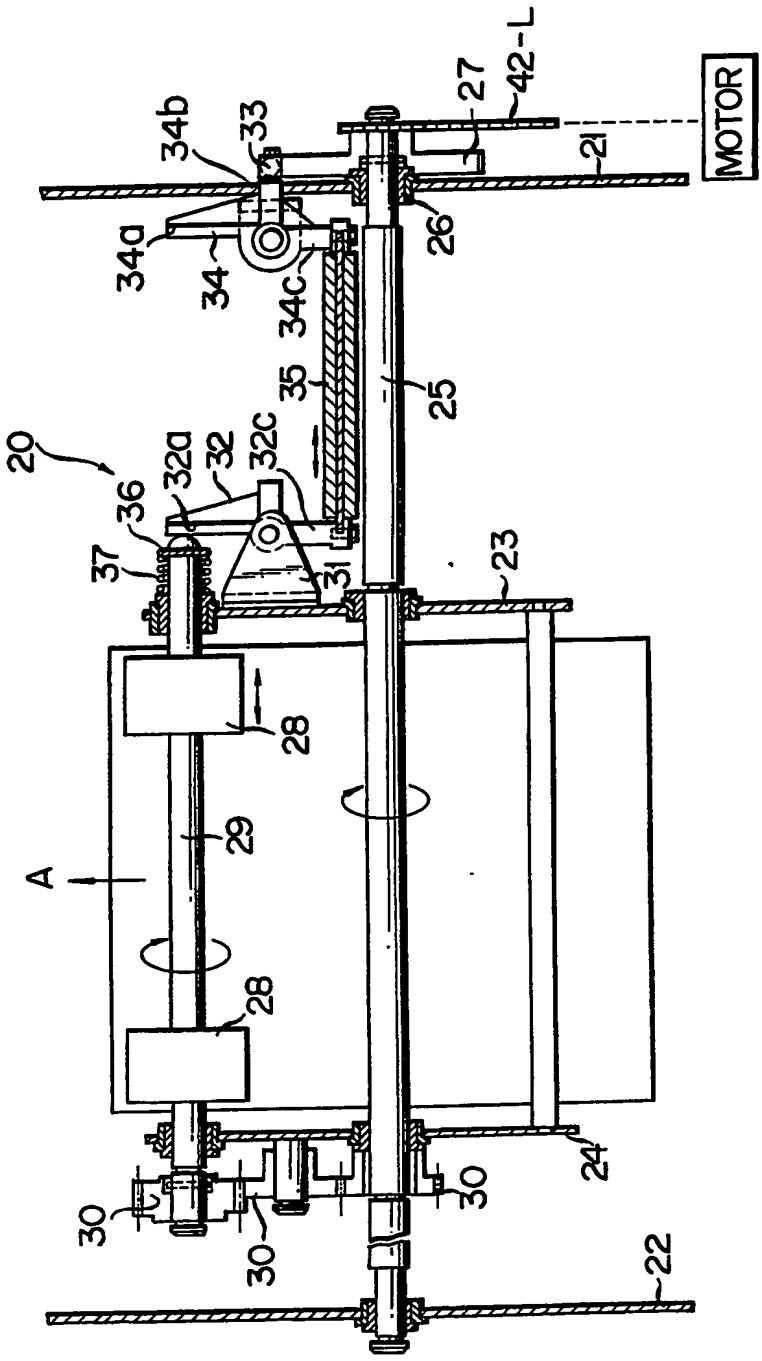

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FIG. 4

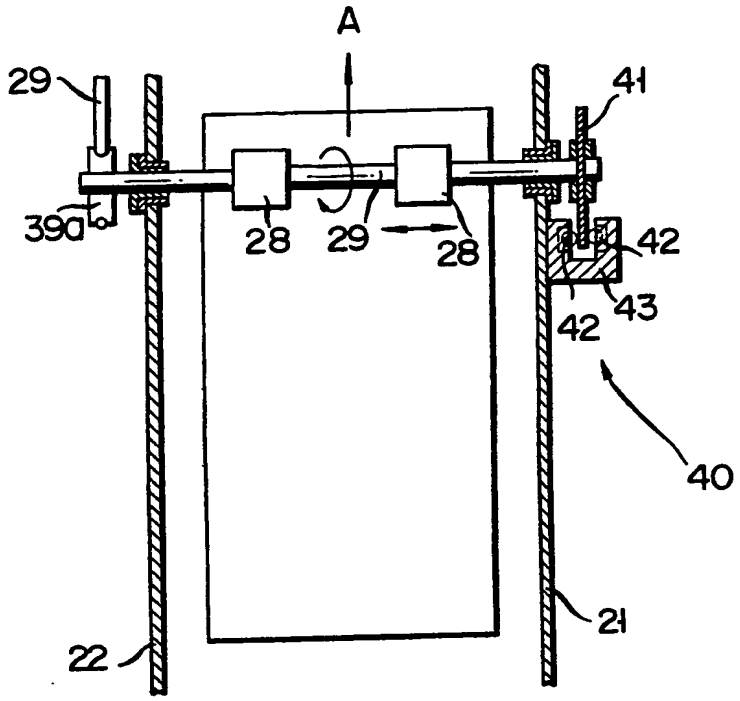

FIG. 5

SPECIFICATION

Automatic paper feed device

This invention relates to an automatic paper feed device for electronic copying machines etc. Which is adapted to cause papers of a paper stock on a tray to be fed one by one by paper feed rollers without involving a "double feed".

Generally such an automatic paper feed device has a "double feed" problem, a state that papers are doubly fed in superposed or overlapped manner. This may cause jamming of papers to occur inside a copying machine.

With the conventional copying machine, papers need to be set, after carefully reshuffled, on a tray so that no "double feed" may occur. Furthermore, a separation finger is provided at each side of the forward and portion of a paper stock so as to permit a paper to be separated from the next adjacent paper. In this case, however, a cumbersome reshuffling operation is necessary. Moreover, there is also a risk that a "double-or triple-feed" will occur. This will cause jamming of papers to occur inside the copying machine, thus lowering an operation efficiency.

It is accordingly the object of this invention to provide a very efficient, automatic paper feed device adapted to impart vibration to paper feed rollers in a direction perpendicular to a direction of travel of a paper fed by the rotation of the paper feed rollers, to cause an uppermost paper to be positively separated from the next adjacent paper of a paper stack to permit papers to be fed one by one without involving any double feed and without a cumbersome paper reshuffling operation.

This invention is further described by way of example by referring to the accompanying drawing in which:

Fig. 1 is a schematic view showing an electrophotographic copying machine;

Fig. 2 to 4, each, are a plan view showing a vibration importing mechanism of a paper supply device according to this invention; and

Fig. 5 is a perspective enlarged view showing a wavy disc of Fig. 4.

In Fig. 1, reference numeral 1 shows a body of an electrophotographic type electronic copying machine. The machine body 1 has a document glass 2 at the upper end. Inside of the machine body 1 is disposed a drum type photosensitive member 3 around which a charging unit 4, exposure unit 5, developing unit 6, transfer unit 7, cleaning unit and so on are arranged along the rotation direction of the photosensitive member 3. An automatic paper feed device 9 is disposed at one corner of the interior of the machine body 1 and a fixing unit 10 and paper delivery rolls 11 are disposed at the opposite corner of the interior of the machine body 1 with the transfer unit 7 interposed between the automatic paper feed device 9 and the fixing unit 10.

The photosensitive member 3, while being rotated, is charged by the charging unit 4, a document on the document glass 2 is exposed by an exposure unit 5 to cause an electrostatic latent image to be formed on the outer peripheral surface of the photosensitive member 3. The developing unit 6 attaches a developer such as a toner etc. to the outer peripheral surface of the photosensitive member 3 to cause the electrostatic latent image on the surface of the photosensitive member 3 to be converted into a visual image. The visual image is transferred to a paper fed from the automatic paper feed device 9. The image on the paper is fixed by the fixing unit 10 and the fixed image bearing paper, after passed through a nip between the delivery rollers 11, is delivered to the outside. The photosensitive member 3 is cleaned by the cleaning unit 8 ready for the next cycle. Thus, one copying operation is terminated. Such operations are repeated according to the number of document sheets. The automatic paper feed device 9 includes a paper stock tray 13, a spring 12 disposed under the tray 13 to cause the tray 13 to be upwardly urged, and a pair of paper feed rollers 28. The automatic paper feed device 9 is such that, each time a copying cycle is effected, a suitable frictional rotation force is imparted by the roller to the top surface of a paper stock on the upwardly spring-urged tray to cause the papers to be fed one by one toward the photosensitive member 3.

In order to prevent a possible "double feed" the above-mentioned automatic paper feed device includes a vibration imparting means, as shown in Fig. 2 to 4. The vibration imparting mechanism is adapted to impart vibration to the top surface of the paper stock on the tray in a direction of the axis of the paper feed rollers i.e. in a direction perpendicular to the direction A of travel of the paper which is fed by the rollers.

A vibration device 20 according to one embodiment of this invention comprises a pair of support frames 21, 22 parallely disposed above the paper feed device 9 which is placed within the body of the copying machine; a pair of support subframes 23, 24 parallely disposed to leave a spacing therebetween which is somewhat wider than the width of the papers on the tray, each of the subframes having a restricted length; a drive shaft 25 journaled in bearings 26 on the subframes 23, 24 and frames 21, 22; a drive cam 27 having concave and convex portions alternately at its outer periphery, and mounted on the bearing 26 on the support frame 21 to drive the drive shaft 25, the drive cam 27 being adapted to be driven by a drive source (not shown) in the machine body; a rotation shaft 29 mounted between the subframes 23, 24, adapted to be driven by the drive shaft 25 through a spur gear wheel 30 which is mounted at the subframe side 24 and between the end portion of the drive shaft 25 and the end portion of the rotation shaft 29, and having a pair of paper feed rollers 28; a first T-shaped rotation level 32 rotatably mounted on a bracket 31 which is in turn mounted on the subframe 23, a first T-shaped rotation lever 34 rotated through a roller 33 in rolling engagement with the drive cam 27, and including an arm portion 34b extending normally parallel to the drive shaft 25 and having the above-mentioned roller 33 at the forward end and an arm portion 34C connected to the later-described interlocking arm; a second T-shaped rotation lever 32 having an arm portion 32a constantly in contact with the end of the rotation shaft 29 and an

arm portion 32c connected to an interlocking arm to be later described; a connection rod 35 connected between the arm portion 32c of the rotation lever 32 and the arm portion 34C of the rotation lever 34; a stopper 36 mounted short of the end of the rotation shaft 29; and a compression spring 37 disposed between the stopper 36 and the bearing on the sub-frame 23.

Fig. 2 shows the state in which the roller 33 on the arm portion 34b of the rotation lever 34 is positioned in one of concave of the drive cam 27. When the roller 33 is positioned on one of convex portions of the drive cam 27 during the rotation of the drive shaft, the arm portion 34C is moved right (on the drawing) to cause the connection rod 34 to be moved to the right. On the other hand, the arm 32a of the rotation lever 32 is moved left i.e. in a direction opposite to that in which the arm portion 32C of the rotation lever 32 is moved. When the roll 33 on the rotation lever 34 is again engaged with the concave of the drive lever 27, the arm portion 32C of the drive lever 32 which is urged by the compression spring 37 to the right is moved to the left and thus the rotation shaft 29 is moved to the right. Incidental with this movement the connection arm 35 is moved to the left and thus the state as shown in Fig. 2 is regained.

In this way, the roller 33 on the rotation lever 34 is continuously rolled on the concave and convex portion of the drive cam to impart a reciprocatory movement to the rotation shaft 29 and thus the rollers 28 in a direction perpendicular to the direction of travel of the paper on the tray, i.e., in the direction of the axis of the rotation shaft. As a result, vibration is imparted to the rollers 28 and thus to the top surface of the paper stock on the tray. The vibratory movement of the rollers 28 cancels out an attaching resistance between the uppermost paper and the next adjacent paper, causing the uppermost paper to be positively separated from the next adjacent paper to permit it to be fed in the direction A under the frictional, vibrator rotation of the roller. Thus, papers stocked on the tray are positively fed one by one without involving a "double feed".

Vibration imparting mechanisms according to another embodiment of this invention will be explained by referring to Figs. 3 and 4.

A vibration imparting mechanism 30 of Fig. 3 comprises a pair of support frames 21, 22 disposed parallel to each other; a rotation shaft 29 journaled in bearings 26 on the support frames so as to be reciprocably moved and over which a pair of rollers 28 are fitted; a cam mounted on a bracket on the support frame 21, having concave and convex portion alternately on its outer periphery and adapted to be rotated in cooperation with a drive source, not shown, within the body of the copying machine; an L-shaped swingable lever 35 mounted on a bracket 33 on the support frame 21 and having a roller 33 at one end which is in rolling engagement with the portion of the cam 32, the other end of the swingable lever 35 being normally in contact with one end of the rotation shaft; a depression lever 38 mounted on a bracket 37 on the support frame 22; and a compression spring 36 disposed between the support frame 22 and the depression lever 38 to cause the rotation shaft 29 to be spring-urged in one direction. The rotation shaft 29 is driven, by a combination of a V belt 39 and V pulley 39a, in interlock with the drive source, not shown, within the body of the copying machine so that it is rotated irrespective of its axial movement. In this case, the combination of the V belt 39 and V pulley 39a prevents their unauthorized displacement away from each other.

During the paper feed time the above-mentioned paper feed device 9 is so operated that the rotation shaft and thus the paper feed rollers 28 are rotated by the V belt 39 and V pulley 39a with the rollers 28 in proper pressure contact with the top surface of a paper stock on the tray. During the rotation of the rotation shaft the cam 32 is rotated to cause the swingable lever 38 to be swung against the urging force of the compression spring 36. In this way, the compression spring 36 is compressed or released and the rotation shaft 29 is reciprocably moved in a continuous fashion, imparting vibration to the rollers 28 and thus the top surface of the paper stock on the tray.

Fig. 4 shows a vibration mechanism according to another embodiment of this invention. This mechanism eliminates the necessity of providing the swingable lever 35, compression spring 36 and depression lever 38 as shown in Fig. 3. The mechanism includes a wavy disc 41 mounted on one end portion of a rotation shaft 29, and a substantially U-shaped housing in which a pair of rolling balls 42, 42 are held in place with a wavy disc 41 sandwiched therebetween such that it can be vibrated.

When the rotation shaft 29 is rotated as in the embodiment of Fig. 3, the wavy disc 41 is rotated in a menner to be sandwiched between the rolling balls 42 and in consequence a pair of rollers 28, 28 are reciprocably, moved while being rotated, along the axis of the rotation shaft 29. In the way, the rollers 28 are vibrated as in the above-mentioned embodiment, while being rotated, to cause an uppermost paper on the paper stock on the tray to be positively separated from the next adjacent paper to permit a one-by-one paper feed.

The vibration imparting mechanism performs the same function even if it is constituted of a plunger type vibrator or a motor and eccentric cam (not shown). The above-mentioned automatic paper feed device may be applied to the other apparatus. This invention may be changed in a variety of ways without departing from the spirit or scope of this invention.

This invention provides a high-efficient automatic paper feed device including a vibration imparting mechanism for imparting vibration to paper feed rollers and thus the top surface of a paper stock in a direction perpendicular to a direction of travel of a paper to cause an uppermost paper to be positively separated from the next adjacent paper to permit one-by-one paper feeding without involving any doublefeed and without requiring any cumbersome paper reshuffling operation.

CLAIMS

1. An automatic paper feed device comprising first and second support frames disposed parallel to

each other; a rotation shaft journaled in the first and second support frames and having paper feed rollers, and a vibration imparting mechanism for imparting vibration to the paper feed rollers in a direction perpendicular to a direction of travel of paper.

2. An automatic paper feed device according to claim 1 in which said vibration imparting mechanism comprises a cam having an equidistantly concave and convex portions alternately at its outer periphery, a roller in rolling contact with the concave and convex portions of the cam, a member for imparting a vibratory force resulting from a rolling contact of the roller with the cam to the rotation shaft, and means for imparting a counter urging force to the rotation shaft.

3. An automatic paper feed device according to claim 2 in which said imparting member comprises a first swingable lever having a roller in rolling contact with the cam at one end, a second swingable lever whose one end is normally in contact with the rotation shaft, and a connection rod connecting the other end of the first swingable lever to the other end of the second swingable lever.

4. An automatic paper feed device according to claim 3, further comprising spur gear wheel for transmitting drive force to the rotation shaft.

5. An automatic paper feed device according to claim 4 in which said urging means has a compression spring around one end portion of the rotation shaft to urge the rotation shaft toward the second lever.

6. An automatic paper feed device according to claim 2 in which said imparting member has a L-shaped swingable lever supported on the first support frame, one end of the lever having said roller and the other end of the lever being normally in contact with the rotation shaft, said shaft is urged toward the other end of the lever by said urging means.

7. An automatic paper feed device according to claim 6 in which said urging means has a vibration imparting lever disposed on the second support frame and having one end portion normally in contact with the rotation shaft and the other end portion against which a compression spring is disposed so as to anchor it between the other end portion of the lever and the second support.

8. An automatic paper feed device according to claim 2 in which said vibration imparting member comprises a wavy disc mounted on one end portion of the rotation shaft and a pair of rolling balls between which the wavy disc is disposed such that it can be vibrated.

9. An automatic paper feed device according to claim 2 or 7 in which the rotation shaft is driven by a V-pulley and V belt.

10. An automatic paper feed device, substantially as hereinbefore described with reference to the accompanying drawings.

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